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Astrology Beliefs among Undergraduate Students

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Abstract

A survey of the science knowledge and attitudes toward science of nearly 10000 undergraduates at a large public university over a 20-year period included several questions addressing student beliefs in astrology and other forms of pseudoscience. The results from our data reveal that a large majority of students (78%) considered astrology “very” or “sort of” scientific. Only 52% of science majors said that astrology is “not at all” scientific. We find that students’ science literacy, as defined by the National Science Foundation in its surveys of the general public, does not strongly correlate with an understanding that astrology is pseudoscientific, and therefore belief in astrology is likely not a valid indicator of scientific illiteracy.

1. INTRODUCTION

Astrology is pervasive in Western society. Nearly every major newspaper and many magazines publish daily or monthly horoscopes; dating websites allow users to search for romantic partners by supposedly compatible “Sun signs;” and numerous prominent celebrities and politicians consult professional astrologers. Astronomy educators frequently encounter confusion between astronomy and astrology, and many dedicate course time in introductory classes for nonscience majors to “debunking” astrology.

However, despite the general awareness that astrology is prevalent and a frequent assumption that pseudoscientific beliefs must be inversely related to scientific literacy, very little research has been done to actually examine what characterizes student belief in pseudoscience. Is belief in astrology an accurate barometer of scientific literacy?

Surveying college nonscience majors is particularly relevant to this debate, as a recent increase in the general public’s scientific literacy has been ascribed to courses like those that served as the setting for the study presented in this paper (Hobson 2008). This results described in this article derive from the results of a study of the science literacy, attitudes, and beliefs about science of nearly 10000 undergraduates. A number of items on the survey instrument were designed to probe pseudoscience beliefs, two of which relate directly to the question of astrology. By examining students’ performance on the science literacy items and their beliefs about astrology, we can determine whether these two constructs are in direct conflict, or if scientific knowledge can coexist with pseudoscientific misconceptions. A better understanding of patterns in students’ belief in pseudoscience may help educators learn the best ways to combat pseudoscience in the classroom, or even if it is necessary to combat it at all.

2. BELIEF IN ASTROLOGY

Although astrology has roots in positional astronomy and was historically considered a science (much as alchemy was), under current constructs of what constitutes science, astrology has no scientific validity. However, astrological beliefs are still very popular with many educated members of modern society. Despite this, surprisingly few rigorous studies have been performed to investigate why astrology is so appealing and persistent. A summary of some of these studies follows, in an attempt to explain the psychological basis for astrological belief.

One of the most frequently referenced causes for belief in astrology is the so-called “Barnum Effect,” which is named after the famous American showman P. T. Barnum. Commonly used in psychology, it refers to a tendency for people to accept vague and general characterizations of themselves as accurate. [Forer \(1949\)](#) found that vague statements such as “at times you are sociable, while at other times you are reserved” tended to impress people as accurate personality descriptions. [Glick, Gottesman, and Jolton \(1989\)](#) demonstrated that although believers in astrology were more likely to accept any type of personality description as accurate, regardless of whether it was positive or negative, skeptics also were likely to fall prey to the Barnum effect, especially if the personality descriptions they were given were positive. Moreover, even astrology skeptics were more likely to call a description accurate if they were told it was based on their sign of the zodiac. Finally, skeptics who were given a flattering horoscope demonstrated an increase in their favorable attitudes toward astrology.

This result is backed up by research that has shown that people are more likely to pay attention to and remember feedback that verifies their positive self-conceptions, and interpret negative or contradictory feedback so as to minimize its impact ([Swann 1990; Markus 1977](#)), which may begin to explain how belief in astrology emerges in the first place. If we assume someone is initially neutral toward astrology, exposure to positively slanted horoscopes and personality descriptions may influence that person toward belief in astrology. [Lillqvist and Lindeman \(1998\)](#) explained in more detail how verification of positive self-concept may influence belief in astrology.

In addition to susceptibility to vague but positive personality descriptions, there is evidence that people may be more inclined to seek astrological explanation for life events when their personal life or the cultural climate is particularly stressful or uncertain. [Lillqvist and Lindeman \(1998\)](#) surveyed adult students taking an astrology class and compared them to students taking nonastrology related classes (German language and psychology). They asked the students about personal crises that they had experienced recently, such as divorce, unemployment, menopause, or economic difficulties. They found that the students who had enrolled in the astrology class had experienced more crises recently than the control group of students. Additionally, the control group was asked about interest in astrology, and those students who demonstrated interest also reported more personal crises in their recent pasts.

In a similar vein, [Padgett and Jorgenson \(1982\)](#) found that during the most chaotic political and economic years in Germany between the two world wars interest in astrology, as measured by published astrological articles, increased with increasing economic and political threat and uncertainty. Similarly, [Sales \(1973\)](#) found an increased interest in astrology during the Great Depression in the United States. In these situations of personal and national crises, astrology may give people an (illusory) sense of control, which is otherwise often absent from stressful situations. Indeed, Lillqvist and Lindeman find that participants reported increased perceptions of control in their lives after taking a class in astrology.

Finally, people may use astrology for much the same reasons as carrying a good luck charm to a high-stakes job interview—as a “just in case” strategy. This may especially be true during stressful times in life, when there is much to gain and very little to lose. [Tolbert \(1990\)](#) framed this as a “cost-benefit” analysis. For most people, there is very little time, effort, and money involved in belief in astrology, so the “cost” is very low. The benefit, even if it is only to your self-concept, self-esteem, and sense of control, might be worth the low investment. (Professional astrologers, of course, put a lot of time and effort into the field, but they also reap a benefit, usually in the form of income.)

[Shermer \(1997\)](#) discussed the same basic concept in the framework of evolutionary psychology. He posited that it was beneficial to survival to make connections between things and events in the environment (red spiders are poisonous), and that there was little to be lost by making too many connections or by making false positives (blue spiders are also poisonous). In contrast, false negatives (red spiders are not poisonous) might be fatal, while false positives are at worst unnecessary (avoiding all spiders). Therefore, Shermer believes humans might be naturally inclined toward superstition, and consequently belief in astrology. After all, a belief in astrology is not likely to have any negative impact on your day-to-day survival.

3. THE SURVEY

The survey instrument used in this study was designed to measure attitudes about science, perceptions of pseudoscience, and general scientific knowledge using forced choice and open-ended questions. The two parts of the survey are set of 21 knowledge-based questions, four of which are open-ended with short written answers and 17 of which are true/false or multiple choice, and a set of 24 statements about science, pseudoscience, and technology where the responses are on a five-point Likert scale. The survey has been administered to students in General Education astronomy lecture courses for freshmen and sophomores at the University of Arizona since 1988. The survey is given in the first week of class, generally before any discussion of astrology or pseudoscience has taken place; it is anonymous, voluntary, and does not count for any part of a student's grade. Typically 10 to 15 min are allowed for its completion. Although the survey is anonymous, demographic information is collected: gender, major, class standing, and number of science courses taken at the university. The instrument is administered on paper, and subsequent data entry and coding are done by hand.

There is a vigorous debate about the definition of scientific literacy and its societal importance, but there is general consensus in the literature that science literacy is composed of (1) knowledge of basic scientific concepts and principles, (2) an understanding of how science works and how it differs from other modes of knowing, and (3) an ability to apply that knowledge and understanding to evaluate science and technology in everyday life (Bybee 1997; Miller 2002; Hazen and Trefil 2009). Our survey attempts to measure some aspects of science literacy with 17 “knowledge” questions with true/false or multiple choice answers. These questions cover a broad range of scientific subjects, from physics (“Which travels faster, light or sound?”) to basic biology (“The oxygen we breathe comes from plants, true or false?”). To obtain a “science literacy score” for each participant, we used 15 of the 17 questions, in order to have maximum overlap with the biannual National Science Foundation (NSF) *Science Indicators* survey. From the answers to these questions, each student is given a score on a scale from 0 to 15, with each correct question worth one point. For a more detailed discussion of the entire survey, plus a description of the data entry and coding process, see Impey *et al.* (2011).

Of special interest to this discussion are the two Likert-scale items related directly to astrology. Students were asked to respond to the statement “The positions of the planets have an influence on the events of everyday life.” While this is not the only principle of astrology, it is the most well-known aspect of astrological predictions because of its ubiquity in the mass media. Additionally, we asked students the forced-choice question: “Would you say that astrology is very, sort of, or not at all scientific?” This question is identical to the question asked by the NSF in its biannual surveys, and allows for direct comparison between our results and the national average.

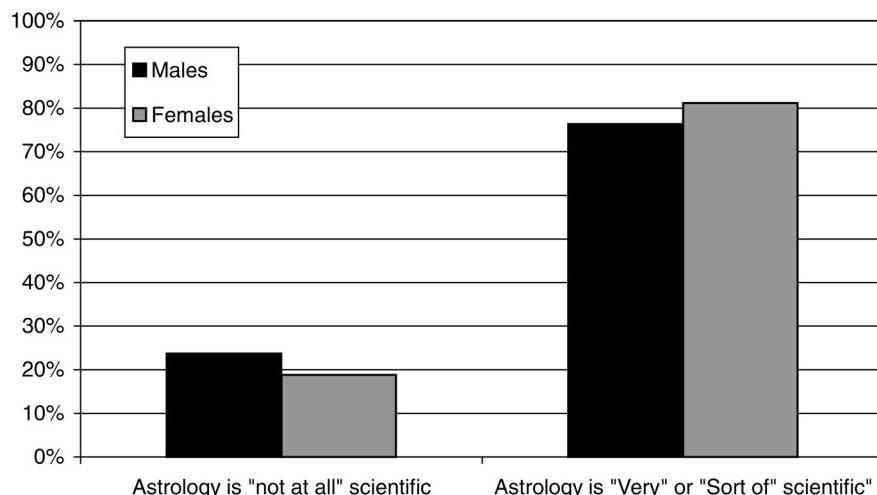
There are some potential problems with the questions as they appear on the survey. As many authors have noted (i.e., Stehling 1990; Thorndike 1955; Cohen 1985), the early history of astronomy is as intimately tied with astrology as alchemy is tied to chemistry. Kepler, Galileo, and Brahe routinely cast horoscopes for prominent politicians of their time (Cohen 1985). Even today, astronomers still refer to the zodiacal constellations when mapping the sky. Additionally, a signature of pseudoscience is that it presents itself with the trappings of science (Shermer 1997), while not subjecting itself to rigorous scientific tests. Knowledge of the historical ties between astrology and astronomy, and/or the fact that astrology presents itself as science, might even cause some professional astronomers to declare astrology “sort of” scientific, despite their awareness that astrology does not adhere to the modern scientific method. The Likert-scale item that specifically talks about planetary positions affecting everyday life should control for this issue to some degree. It also does not contain the word “astrology,” in order to avoid any potential confusion that students may have concerning the phonetic and morphological similarity of the words “astrology” and “astronomy.”

4. RESULTS BY DEMOGRAPHIC

Figure 1 presents the overall results to the two astrology items, broken down by gender. Only 22% of all students state that astrology is “not at all” scientific. Similarly, only 29% of students “disagree” or “strongly disagree” with the statement that the planets affect everyday life. There is a slightly greater tendency for females to adhere to the principles of astrology, a result that has been duplicated by the NSF and others researchers (e.g., DeRoberts and Delaney 1992, 2000).

Table 1 and Figure 2 present results on the astrology questions, broken down by major and number of science courses completed. Science majors, not surprisingly yet gratifyingly, perform better than their counterparts in other fields. Similarly, the fraction of correct responses rises with the number of science classes that students

Would you say that astrology is very, sort of, or not at all scientific?



The positions of the planets have an influence on the events of everyday life

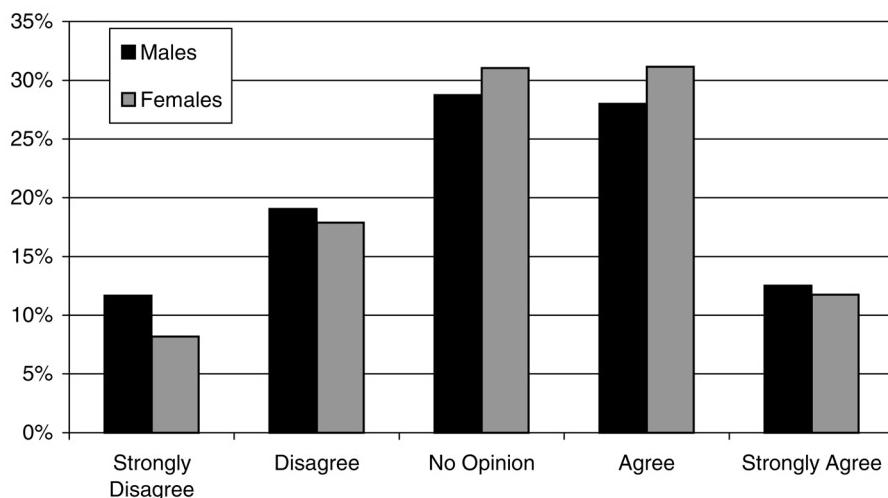


Figure 1. Responses to the two astrology items, broken down by gender. There is a modest but statistically significant tendency for female students to state that astrology is sort of or very scientific, as well as to demonstrate agreement with the idea that the planets affect everyday life. Note that a very small percentage of students strongly agree with this idea, and the gender discrepancy for that particular response is statistically insignificant (12.5% of males and 11.8% of females chose strongly agree).

have completed. If we measure the success of our science curricula by the ability of students to distinguish pseudoscience from hard science, this could very well indicate an encouraging, although not great, success rate. However, despite the fact that students who have completed three science classes—the number of classes required to fulfill the General Education requirement at the University of Arizona—perform twice as well as students who have not yet taken any science, only 30% of these students answer the astrology question correctly. Figure 3 reports result by class year. Seniors in nonscience majors perform surprisingly well, matching the performance of science majors and students who have taken four or more science classes.

5. COMPARISON TO NATIONAL FINDINGS

Every two years as part of the *Science and Engineering Indicators* series, a document prepared by the National Science Board, which guides scientific policy and strategy for the U.S. government (the NSF), conducts a survey to ascertain public understanding and attitudes about science and technology. As previously mentioned, the survey asks the question: “Would you say that astrology is very, sort of, or not at all scientific?” Since 1979, the NSF has recorded a gradual decline in belief in astrology, indicating a trend toward fewer Americans believing

Table 1. Correct responses by major. Students majoring in the sciences perform notably better than students in other colleges, although still only half of science students state that astrology is “not at all” scientific. Over 80% of our future doctors and nurses, teachers, and business people believe that astrology is very or sort of scientific.

Major	Percentage responding that astrology is “not at all” scientific (%)
Medicine/Nursing/Pharmacy/Public Health (<i>n</i> = 52)	7.7
Architecture/Management/Business/Law (<i>n</i> = 2347)	16.5
No major selected, undecided, blank (<i>n</i> = 1122)	18.8
College of Education (<i>n</i> = 336)	19.0
Social and Behavioral Sciences (<i>n</i> = 1127)	24.7
Fine Arts/Humanities (<i>n</i> = 851)	29.1
Engineering and Agriculture/Life Sciences (<i>n</i> = 211)	36.0
College of Science (<i>n</i> = 216)	51.9

that astrology is scientific. The most recent data reports that around 60% of all adults and around 50% of people in the 18–24 year old or college-age group state that astrology is “not at all scientific.” This result is notably different from the results obtained using our survey instrument.

It is not entirely clear why our results indicate a much higher degree of confusion about the scientific validity of astrology, although there are several possibilities. First, the NSF survey is typically given over the phone, while our survey is paper-based, which could have an unpredictable effect on responses. Second, our survey is given in the context of an astronomy course, which could unintentionally bias the results or increase confusion due to vocabulary confusion between astrology and astronomy. This is also one factor that may change in the context of a phone survey, where subjects hear the word rather than reading it on the page. Finally, our survey population is largely from the Southwest, which may introduce a regional effect that distinguishes the two sample populations. Since the NSF does not report results by state, it is not possible at present to test this final hypothesis.

6. SCIENCE LITERACY AND ASTROLOGY

One of the common assumptions about astrology is that students who know or who understand more science are less likely to subscribe to the principles of astrology, or be susceptible to the other forms of

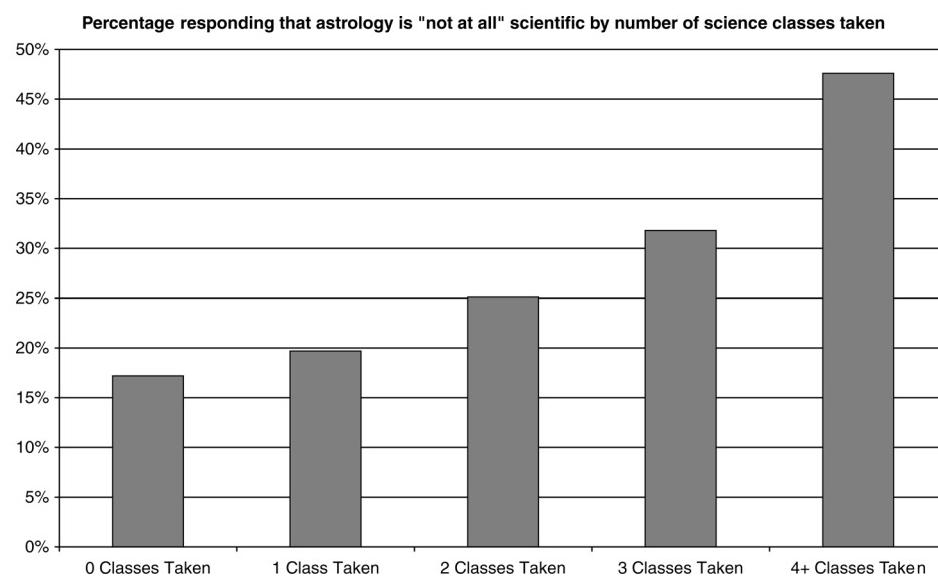


Figure 2. Responses by number of college science classes completed. After completion of the General Education science requirement of three courses, correct responses have nearly doubled. Many students who have completed four or more science courses are science majors.

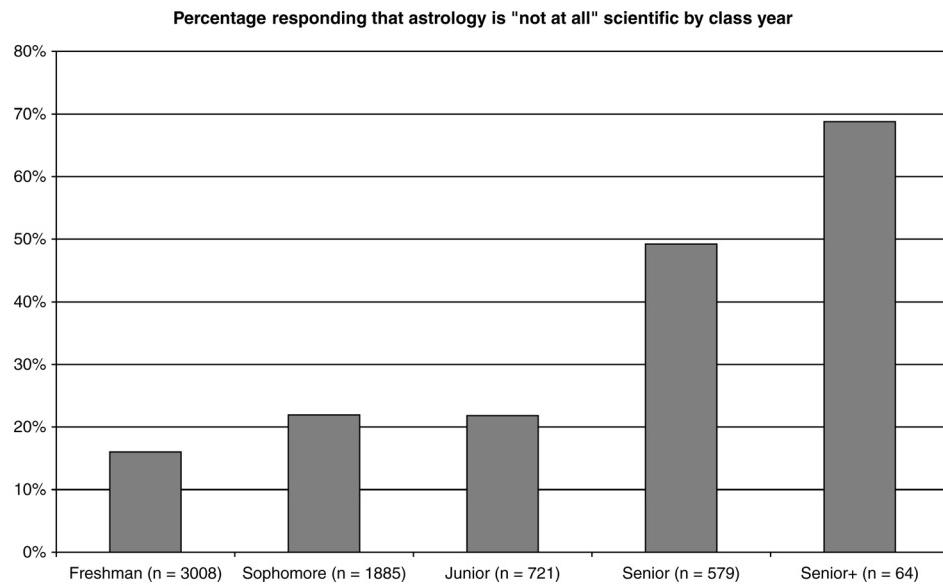


Figure 3. Responses by class year to the forced-choice astrology question. The n size is quite small for seniors, but overall there is a strong trend of increasing awareness that astrology is not scientific as students pass through the university, regardless of major. Only 5 students did not report their class standing, and are not included in this graph.

pseudoscience, presumably because they have learned critical thinking skills and the scientific method along with their factual knowledge. The 15 content-knowledge questions contained in our survey allow us to carefully consider this assumption.

Figure 4 examines the relationship between correct answers to the science knowledge questions and a correct response to the forced-choice astrology question, where “astrology is not at all scientific” was scored as being correct and “astrology is ‘very’ or ‘sort’ of scientific” was scored as being incorrect. As can be seen in the graph, students who answered the astrology question correctly had an average science literacy score of 12.5 (83%) and those who answered incorrectly had an average score of 11.5 (77%). There is a small but significant correlation between overall science literacy score and being able to identify astrology as not at all scientific ($r_{pb} = 0.21$,

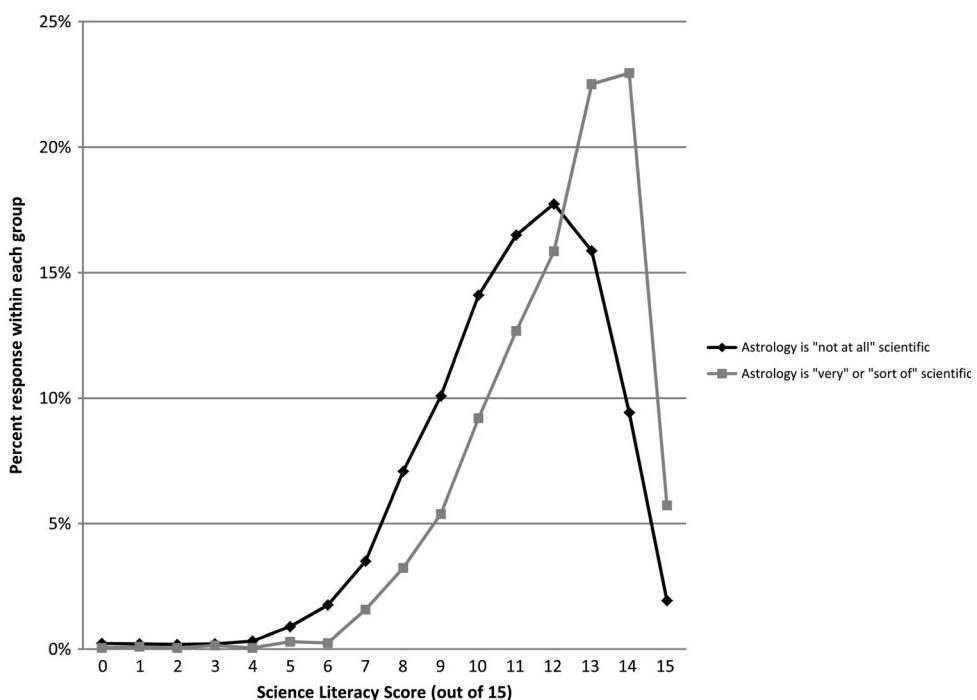


Figure 4. The relationship between overall science literacy scores (out of 15 questions) and responses to the forced-choice astrology question. The number of responses has been normalized for clarity.

$p < 0.01$). Similarly, students who state that they strongly disagree or disagree that the positions of the planets influence everyday life answer an average of 11.6 questions correctly, while students who “agree,” “strongly agree,” or have “no opinion” answer 11.0 questions correctly. (Students who agreed and had no opinion were binned for analysis.) These results very likely are related to the data discussed above, which demonstrated that science majors, seniors, and students who have taken more science classes were more likely to answer the astrology question correctly. The difference of one question right or wrong is hardly a dramatic demonstration of an improvement in scientific literacy. In general, the results of our survey indicate that belief in astrology is *not* strongly linked to scientific literacy. Belief in astrology is also relatively impervious to a college education. Therefore, the frequent use of astrology as an indicator of scientific literacy or as a symptom of general scientific illiteracy appears to be invalid.

7. PSEUDOSCIENCE BELIEFS AND SCIENCE KNOWLEDGE

Figure 5 and Table 2 presents the results to five additional statements relating to science and pseudoscience beliefs, as well as the astrology question for comparison. Astrology is the second-most prevalent belief in our sample among the five pseudoscience examples, followed by the idea that “some people possess psychic powers.” Students demonstrate the most skepticism toward the idea that “some ancient civilizations were visited

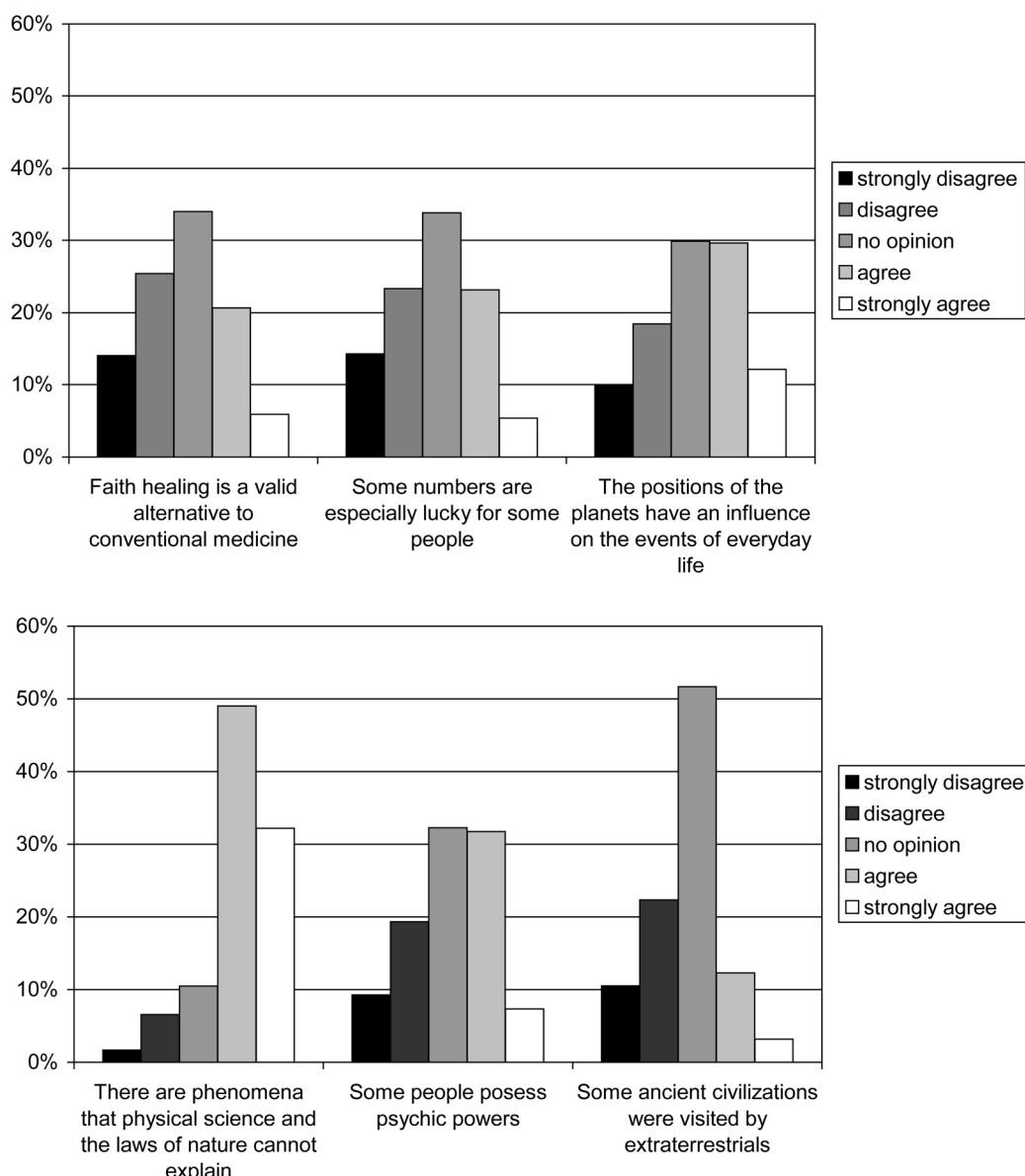


Figure 5. Responses to statements concerning science and pseudoscience beliefs. The astrology question is also displayed for purposes of comparison.

Table 2. Percentage of students responding to the statements about pseudoscience and the paranormal.

	Strongly disagree (%)	Disagree (%)	No opinion (%)	Agree (%)	Strongly agree (%)
There are phenomena that physical science and the laws of nature cannot explain	1.69	6.59	10.50	49.01	32.22
Some people possess psychic powers	9.27	19.31	32.29	31.77	7.36
Some ancient civilizations were visited by extraterrestrials	10.53	22.34	51.66	12.31	3.17
Faith healing is a valid alternative to conventional medicine	14.05	25.42	33.99	20.67	5.87
Some numbers are especially lucky for some people	14.28	23.34	33.84	23.18	5.35
The positions of the planets have an influence on the events of everyday life	9.90	18.45	29.89	29.62	12.15

by extraterrestrials.” These results, taken from our larger instrument to diagnose science knowledge and attitudes, indicate that astrology is part of a larger landscape of susceptibility to pseudoscience thinking among college undergraduates.

A similar analysis to that performed for astrology shows that the acceptance of pseudoscience often coexists with strong performance on science knowledge indicators. We conclude that the prevalence of belief in astrology among college undergraduates does not imply poor scientific literacy, as measured by an instrument similar to that used to guide public science education policy. Pseudoscience beliefs are widespread, and are somewhat mitigated by college science classes, but they can coexist with legitimate scientific knowledge. Particular instructional strategies designed to combat belief in astrology may not have a larger benefit. In a future paper, we will present a broader view of levels of science knowledge and their relationship to various pseudoscience beliefs, with a view to informing the current debate on scientific literacy and suggesting instructional strategies to more broadly instill scientific ways of thinking in nonscience majors.

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